MAGNETIC FIELD SENSOR BT52i

USER'S GUIDE

CENTRE FOR MICROCOMPUTER APPLICATIONS

http://www.cma-science.nl

Short description

The Magnetic field sensor BT52i measures magnetic field strength. It has two measurement ranges, -100 .. 500 mT and -10 .. 50 mT, which can be selected using a push button located on the top of the sensor box. When the push button is pressed down, the range -10 .. 50 mT is selected, when the push button is in the upper position, the -100 .. 500 mT range is selected.
The Magnetic field sensor uses a Hall-element as its sensing element. This element is mounted at the tip of the stainless steel tube, at the position 0 cm indicated on the metal tube. The face of Hall element is directed perpendicular to the direction of the stainless steel tube and the sensor is most sensitive when the metal tube is positioned parallel to magnetic field lines. The sensor is therefore very suitable for measuring the magnetic field inside coils, or near (very strong) permanent magnets. The sensor is less suited to measure the magnetic field in slit-shaped cavities. Because the output signal of a Hall-element is very small, the Hall-element is contained in an integrated circuit with a differential amplifier with temperature compensation in order to get a good quality output signal.

Note: *The values obtained by the sensor will be sensitive to the position in the magnetic field and the orientation of the sensor to the field direction. A false low value could be achieved if the direction of magnetic field is not parallel to the direction of the sensor tube.*

The CMA Magnetic Field sensor BT52i can be directly connected to the analog BT inputs of the CMA interfaces. The sensor cable BT - IEEE1394 needed to connect the sensor to an interface is **not supplied** with the sensor and has to be purchased separately (CMA art. code BTsc_1 or BTsc_4).

Sensor recognition

The Magnetic Field sensor BT52i has a memory chip (EEPROM) with information about the sensor: its name, measured quantity, unit and calibration. Through a simple protocol this information is read by the CMA interfaces and the sensor is automatically recognized when it is connected to these interfaces. Each measurement range of the Magnetic field sensor has its own EEPROM information. The position of the push button determines which information is used. To be able to detect to which of the ranges the sensor is set first disconnect the sensor from an interface, select the desired measurement range with the push button and then connect the sensor to the interface again.
If your Magnetic Field sensor is not automatically detected by an interface you have to manually set up your sensor by selecting it from the Coach Sensor Library.

Calibration

The CMA Magnetic Field sensor BT52i is supplied calibrated. The output of the sensor is linear with respect to the magnetic field strength. The supplied calibration functions are:

-10 .. 50 mT range: $B\ (mT) = 50 * V_{out}\ (V) - 10$
-100 .. 500 mT range: $B\ (mT) = 500 * V_{out}\ (V) - 100$

The Coach software allows selecting the calibration supplied by the sensor memory (EEPROM)

or the calibration stored in the Coach Sensor Library. The Coach program allows shifting the pre-defined calibration or creating a new calibration if needed. Use the *Set to zero* option in Coach to adjust the zero point of the sensor.

Suggested experiments

The Magnetic Field sensor can be used in various experiments such as:

- Measurements of the magnetic field near a (strong) permanent magnet.
- Measurements of the magnetic field near a current-carrying wire.
- Measurements of the magnetic field near or inside a coil or solenoid.
- The variation of the field when alternating current flows through a coil.

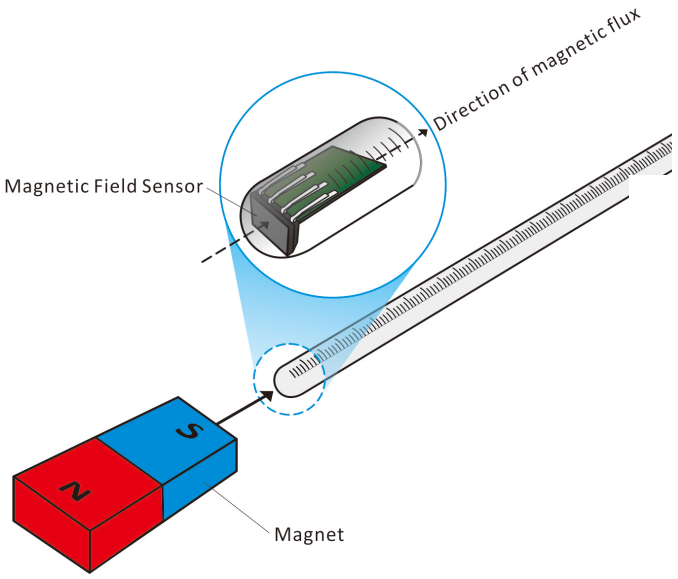

Figure. Measuring the magnetic field near a permanent magnet.

Magnetic field strength measurement

Magnetic field strength (also known as the *magnetic flux density*) is a measure of the force the magnetic field will exert on an electric current or another magnet.

In S.I. units magnetic field strength is expressed in teslas (T). In cgs units magnetic field strength is expressed in gauss (G).

$$1\ G = 1 \times 10^{-4}\ T = 0.1\ mT \text{ and } 1\ mT = 10\ G$$

Below are given magnetic field strength values of exemplary magnetic sources.

Magnetic field strength in mT	Magnetic field source
$10^{-10} – 10^{-9}$	The human brain magnetic field
0.031 - 0.058	The Earth’s magnetic field on its surface
2,5	The Earth's magnetic field in its core
5	A typical refrigerator magnet
10	A small iron magnet
200	A small neodymium-iron-boron (NIB) magnet
1500 - 3000	A medical magnetic resonance imaging electromagnet

Technical Specifications

Sensor kind	Analog, generates an output voltage between 0 .. 5 V
Measurement ranges	-10 .. 50 mT -100 .. 500 mT
Resolution using 12 bit AD converter	-10 .. 50 mT range: 0.024 mT -100 .. 500 mT range: 0.24 mT
Calibration function	-10 .. 50 mT range: B (mT) = 50 * V_{out} (V) - 10 -100 .. 500 mT range: B (mT) = 500 * V_{out} (V) - 100
Accuracy	± 5 %
Voltage offset	0.5 V ± 3%
Current requirement	Max. 60 mA
Operating temperature	0 .. 50 °C
Connection	IEEE1394 connector for BT-IEEE1394 sensor cable. Sensor cable is **not delivered** with the sensor and has to be purchased separately (CMA art. code BTsc_1 or BTsc_4).

Warranty:

The Magnetic Field sensor BT52i is warranted to be free from defects in materials and workmanship for a period of 12 months from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

Note: *This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.*

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